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PHILOSOPHICAL TRANSACTIONS.

Monday, Januar. 11. 166⁸₉.

The Contents.

Divers Communications relating to the Queries about Vegetation, formerly publish'd. Answers to some of the Queries here-tofore recommended to Sir Phil. Vernatti in Java Major. A Summary Account of the General Laws of Motion by Dr. John Wallis, and Dr. Christopher Wren. An Account of two Books: I. HISTORIA CÆLESTIS Observacionum Vicennialium TYCHONIS BRAHE II. ANDR. TACQUE ET Opera Mathematica.

*Some Communications,
Relating to the Queries about Vegetation, publish'd in
Numb. 40 of these Tracts.*

THe Argument of *Vegetation* is exceeding noble, largely usefull, and worthy to be expos'd to publick consideration, and a general and accurate discussion; to the end, that where Observations are uncertain, and Experiments fickle, or failing, or casual, the various Track or operation of Nature may be the better discover'd by the greater store of confronting Trials and Observations. 'Tis for this Reason, that we not only suggest and disperce *Inquiries* upon this important Subject, but are also ready to impart such Informations, as we receive from the Curious and Inquisitive of what they have experimented and observed therein. At the present we shall insert here, what hath been communicated (upon the *Queries* formerly

merly publisch'd) by those two Worthy and Observing persons Dr. *F. Beale*, and Dr. *Ezreal Tonge*.

To the 1. Dr. *B.* It will be difficult to enumerate all the Vegetables that will grow the wrong end set downwards in the ground. To mention some, besides those mention'd in that *Query* (viz. *Elders* and *Briars*) there are *Sallies*, *Willows*, the *Black-Elder*, *Vines*, and most *Shrubbs*; two or three of their joyns being cover'd in the mould, and the Stem cut off near the overmost Joyn, which should be half cover'd in the mould, and the mould somewhat raised, as it spirits out and grows. Dr. *Tonge* agrees, saying, that *Curran Trees*, and such like, as are of a soft wood, and quick growers, seem most apt to this improvement.

To the 2d. Dr. *B.* That the branch of a Plant, being laid in the Ground, whilst yet growing on the Tree, and there taking root, being cut off whilst so growing, will grow on both ends, if it be well rooted in the Propagation; and the like care had of the last knot or joyn, as was before prescribed. Dr. *T.* saith, that Layers of those Trees, mentioned in the former *Query*, will grow on both ends, and aptly parted when they have spread roots both wayes, make two plants out of each Layer.

To the 3d. Dr. *B.* In the *Tapping* of Trees, the juice certainly ascends from the root, and after 'tis concocted to partake of the nature of the Plant (which feeds as well on the Air, as the juice furnish'd through the root) it descends (as the Liquor in a *Limbec*) to the orifice, whence it issues. *Ratray*, the learned *Scot*, affirms, that he had calculated experimentally, that the liquor, which may be drawn from the *Birch* in the Spring time, is equiponderant to the whole weight of the Tree, branches, roots, and all together: Whence he inferrs, that it deserves our diligence, fully to enquire into the manifold benefits that may be made by the Tappings of all sorts of Vegetables; some at the Roots, some in the Body, either from the Bark, or the Timber; some under the chief Branches (which is noted by *V. Helmont* to be the proper place for the juice of the *Birch*;) some from the Fruir, Kernel, B'ossoms, Seeds, or Husks containing seeds; as Dr. *Harvy* had a way of filling his Silver-box with a purer sort of Opium, taken from the Husks of *Poppy*-seed, being pricke after

after some time of exsudation and insolation. The like whereof may be tried upon the *Male peony*, and other Plant's of greatest fame and vertue ; as well for Gums, Colours, Odors, &c. as for famous Juices. Mr. *Evelyn* can acquaint you of a Receipt, which he had in *Italy*, as a Specifick against *Feavers* from the *Tappings* of the *Elme*. I hear as much praise from the *Oak*, for stopping the *Flux* of *Bloud* by the way of Urine, whether it proceeds from the imbecility of Nature, or from the defects in the Bladder, Reins, or other inward passages. Some say as much for the Juice of the *Alder* (though the *Dwarf-Alder* hath the highest praise) to cure or stop the *Dropſie*. And perhaps this large *Natural Limbec*, where it may be had, may sometimes prove more effectual, than our little, Artificial, and more troublesome *Distillations*. And the Congeniality of the Sun in his alternative visits, and the affiluous intercourse of the free Air, with the Spirit of the Plant yet living and growing, may have a more effectual influence for a Specific vertue, than we are apt to imagine. Though we cannot see nor hear the Lungs of Vegetables beating, yet we may sometimes smell their Breath strong enough, both to please and offend exceedingly ; as in *Savin*, *Firrs*, *Cypress*, *Elder*, *Rosemary*, *Mirtles*, and generally in all *Blossomers*. And some that cannot be smelt by us, may yet have a very wholesome breath. One Experiment I will here bestow on you. When both my hands were manacled for many years (and sometimes my Armes also) with deep corroding *Teaters* ; to the blush of my many friendly Physitians, and in despite of many of the best Medicines and Purgations, all was suddenly heal'd, and hath so continued these 20 years, by the application of the *Gum* of *Plum-trees* dissolved in *Vinegar*. I must not forget to add, that I applyed *Vine-leaves*, and sometimes open'd *Raisins* to draw a moisture from those *Teaters* some few dayes before I used the *Gum*.

Dr. *T.* is of opinion, that *Sap* alwayes rises, and never properly descends, having onely a kind of subsiding or recidivation, which he saith he cannot call a Circulation, nor resemble to the motion of Liquors in a *Pellican* ; but rather to the sinking of Liquors in an *Alembec* , whilst the thinner parts are forced over the helm ; yet somewhat imitating the motion of

Blood in Animals, forasmuch as it continually supplies the want and expence of Sap in the exterior parts, from the stock of the sap in the Trunk, root, and branches. He understands it thus; That the Sap, necessary to the growth of the leaves, fruit, and upper branches, being dispensed and converted into the form necessary for those purposes, when the Tree is fullest of Sap, in such manner that the Sap in the innermost Coats feeds the innermost, and the sap of the outward coats the outward parts, of Fruits, &c. that which remains in the Body betwixt the several coats, and betwixt the Bark and Body, begins to condense there also, first into a Gely, and after into Wood, Bark, Roots, &c. according to the several places to which it hath sub sided. And because it condenseth faster in some parts than in others, according as they be higher or lower, (whether it be by heat or cold, or exhalation of thianer parts) the sap condensed above or below, filling less room, must needs cause the sap, which is not yet condensed, in appearance to descend or subside, and to sink as it were lower and lower in the pores of the Timber and Bark, i.e. to be less high, not descend from any place, to which it was formerly risen, unless (as in *Blood-letting*) when some lower part is open'd, all the sap above continually flowes thither, till the Tree be emptied, or the continual flux of the Sap (the natural Balsome of the Tree) heal the wounds, as that of the Blood does those of the Body; and so much quicker and easier, by how much the Air is more favorable, or is better kept out; which he observes for their direction, who are curious in *Inoculation*, as the ground of their successes or miscarriages.

The Trees observ'd by the same Dr. T. to run, are the *Vine*; the *Birch* plentifully, at body, branches, and roots; the *Wal-nut-tree*, at the roots and prun'd branches; some *Willows* and *Sallyes*, and some sorts of *Maple*; the *Sycamore*, which is the greater *Maple* (some call it the *Plane*) at a gash made on the bark of his body, and at the root and branches; the *Poplar* and *Asp*: The *Elme* and *Oake* are referr'd to tryal; concerning which last some Wood-men affirm, that in such of them as are Wind-shaken, that have large hollownesses in their Armes and Bodies, they have found great quantity of sap in the cutting of them, whereof having drunk, they quenched their thirst without any prejudice.

prejudice. To these add the *Whitting*, or *Quicking-tree*, (Lat. *Fraxinus Sylvestris*, and by some *Fraxinus Cambro-Britanica*) which in its season, as some affirm, will run pleateously, and whence they would have us expect a soverain Drink against some stubborn distempers, especially such as are *Scorbutical* and *Spleenick*. I have kept (saith Dr. T.) some of the Juice of the Berries (which being express'd ferments of it self) these two years in Bottles, and it hath now the taste of an austere Cyder: And I suppose from its gratefull smell, that it may be kept till it ripen and become a strong Vinous Liquor. It is the Household drink of some Fam lies in these parts about *Wales* and *Herefordshire*, and some out of Curiosity have brew'd ripe Berries with strong Beer and Ale, and kept it till it transcended all othe: Beer in goodness.

Dr. Tonges attempts upon the *Poplar*, *Aspe*, *Elme*, *Oake*, *Ashe*, *Elder*, *Whitting-berry* or *Quicking-tree*, *Thorn*, *Buckthorn*, *Tile*, *Nut*, *Sloe*, *Briar*, *Bramble*, &c. have not succeeded; and he doubts, that they, and all *Apples* and *Pears* have some degree of Gummynes in their Juices, so that they will not run.

To the 4th *Query*, D. B. Apparently the sap riseth by the inward Birk, where you may see the quick begin, and where the Graft first incorporateth.

Dr. T. There are Circles observ'd in Trees, which are the distances of those Films or Coats, by which the Tree receives its yearly increase in thickness. Through these, looking full of Circular Pores, the Sap seems to ascend in the same manner between coat and coat, as between the Birk and the Body; and probably between the two outermost of these Coats, as large a quantity of Sap, as between the Birk and Body. Now the Ascent of Sap is by all parts and pores of the Tree, in such small quantities, as can hardly be discerned, unless the Tree be quite saw'd off, especially near the Root; for then it will appear, how it ascends. In *Birches*, and such like, the Sap issues very plentifully in all parts of the body, when they are cut down near the Root. And in other Trees that have Pith, as the *Willow*, &c. it may be observ'd, when they are saw'd asunder near the Root, whether any Sap issues or no by the Pith?

The Bark is double outward and inward. The outward is dry,

dry, and in some Trees rough. The inner, is probably a super-added new Coat of that years growth, or something like it, between the nature of Wood and Bark. The sap rises within and without that super added Coat.

From hence it may be more carefully inquired than hath been hitherto done. 1. Whether the more Circles there be in any Branch, the longer the Sap will ascend into it? 2. Whether the fewer Circles there are in it, the sooner the Sap subsides from it? 3. Whether a Branch (suppose) of three Circles, cut at Spring, the sap ascending, or another of the same bigness, will at Michaelmas following, if cut again, be found to have increased one or more Circles than it had in the Spring: and whether at Spring or Fall, or at other season, it be found to have a Circle or half a Circle of Pricks next or betwixt the Barks, or a Circle of Wood next the inner Bark onely, or both? But here the Comparison is to be made with distinction. For it must be inquired, Whether some Trees shoot new Tops every year until a certain Age, and after not? Whether some have the Circles in their Branches decreased from their Body to the extremity of the Branch in such order, that (e.g.) an Apple-tree-shoot of this year hath one Circle of Pricks or Wood plac'd in the Graft of two years old, and that of two years growth will the next year have one Circle more then it had the year before? And whether this onely be till the Branch shoot no more Grafts, and whether then the uttermost Twig get any new Circles, or stand at a stay, being nourish'd onely, not augmented in bulk as to the appearance of the Circles? And whether an Augmentation be between every Coat, or upon the outward Coat onely? Here it ought also to be enquired, Whether the Circles of pricks do encrease till Midsummer, and the Circles of wood from after Midsummer till next Spring?

Further, to perfect the experiment about Sap, and to find, Whether it ascends more or less in the prickt Circles of the Body, than in those betwixt the Body and the Bark; let the Tree be first pierced with an Auger onely through the Bark, and the quantity of Sap it yields in an hour, exactly measur'd and weigh'd; Then at the same time let another hole be bored into the Body of the Tree above an inch and an half deep, and so round about

on every side of the Tree, some deeper, and some shallower, with a good large Auger ; and one quite through sloaping. From which Experiment, after various tryals, may be found the difference of the Sap rising on the *North* and *South*, and so likewise of that which comes from the Bark onely peel'd off, and that which ascends in the inner part of the Tree. The weight also may be compared of that which issues from the Bark, with that, which issues from the Body. The internal Heart-sap may also be drawn apart, by boring a smaller Auger-hole in the middle of a greater, and fitting it with a long pipe, adjusted to that inner orifice. If no difference be found in these, the presumption will be greater, that the difference of *Heart* (as when they call *heart* of *Oake*) and *Sap* in Timber is not from the plenty or scarcity of sap, but from the season of felling. This Interception of the *Heart-sap* may have an effect analogous to the boring out the *Heart*.

To the 5th. Dr. B. saith ; I answer Experimentally, That if a Circle be drawn round about any common English Tree, as *Oak*, *Elme*, *Poplar*, &c. by Incision to the Timber (how thin soever the Knife be) so that no part of the Rind or Bark to the very solid Timber be un-cut, the Tree will die from that part upwards. Onely the *Ashe*, (of all that I could try) will grow on, and prosper notwithstanding the incision. My Brother (T. B.) shew'd me some old and huge *Ashes*, which were bared of the Bark by the Deer, from the root 4 feet upwards quite round ; yet they had continued their growth many years, and some parts of the Bark, which were left in few places not so broad as the palm of my hand, had a fresh verdure more lively then the parts of the Bark which remain'd above the baring. Yet if some Incisions by hickings be made, or if the Branches of some Fruit-trees (especially the *Gennet-moyle*) be quite bared under a knot near the body of the Tree, and that knot and bare part be well cover'd with loame or good mould in *June*, that branch will not onely survive, but will be apt to take root and become a young Tree of speedy growth, if cut off below the baring, and set at a fit depth at the end of *Autumn*, or about *Candlemas* rather. Where such transverse hickings are made, or Contusions in the Bark, many Vegetables are apt to gather knobs,

knobs ; and sometimes small branches will spirt out above, and sometimes about the part contused. To get the *Gum* of *Plum-trees*, I have sometimes wrench'd the branch, till the solid Timber hath crackt, and the Rind forc'd open in some parts ; so leaving it to grow, but forc'd to continue in a posture somewhat wreathed, it hath not fail'd to yield me store of *Gum* next Summer.

Dr. T. A Branch, whose Bark of the breadth of about 2 or 3 Inches is taken off round towards the bottom, in some Trees, and particularly the *Lime-tree*, will live, and bear leaves for many years, and grow, as other branches, by means of the Sap ascending through all the pores of the inner Coats, as was said above to the 3d *Q.* And it ought to be well observed, in what other Trees this will hold, and especially, whether it will not hold in all Trees, whose Sap runs not out very plentifully : for, in such Trees, wherein there is a plentiful Issue of the Sap between the Bark and Body, probably the Branch will die ; besides, some Air, as that of *North* and *North-East*, presently blasts open'd Trees.

To the 6th. Dr. B. Concerning the Use of the *Pith* in Vegetables, as whether the Juyce ascends or descends by it ? It may be consider'd, That my Answers above do import that the Juyce, which descends by Tapping, and which maketh the pulp or coat of any fruit, ascends by the Bark or Rind of the Plant, not by the Pith. I now add (which I can affirm by many Experiments) that the *Pith*, and the Timber have some correspondence with the *Seed* of the Plant, to convey an ente course of the same Spirits and nature from the *Root* to the *Seed*.

The Experiments themselves, whereby the Worthy Doctor maketh this out, we must refer to another opportunity ; as also his considerable Discourse already in our hands, giving Instances to shew, That there is a peculiar Correspondence, not onely between the Seed and the Pith, Heart or Timber of Plants ; but also between the Bark or Sap in the Bark, and the Pulp of the Fruit, or some encompassing Coat or Husk, or Cod, which contains the Seed.

Dr. T. answers to the same *Q.* *Piths* are of a very different nature and substance. In the *Walnut*, is a multitude of films manifestly distant from one another. In others, as in *Elders* and

and *Briars*, 'tis a continued, soft, loose, dry substance. In the *Walnut*, an observation may be made, by cutting a small and young branch, which hath the largest pith, in *March*, to the Pith in some branches, and through it in others of the like bigness: Whether any Sap issues out or no by the Pith, will be found by the quantity of the Sap issuing from the one and the other compar'd.

The Observations a'so of the Effects of *Boring* and *Pegging* the Pith, are reserv'd to the like tryal about the same time. But 'tis probable, that if the whole Pith be forc'd out, the place so bor'd will be fill'd with *Sap*, which will gelly there, and at length be converted into wood; as 'tis conceiv'd it does yearly between the abovesaid films, coats, and in all the pores of the Body of the *Tree*, and in those of the *Bark* proportionably. For, the Sap issuing from the *Birch*, cut down, turns into a white Gelly on the head of it; and likewise in those holes that are bor'd in the body of the *Birch* about *March*, by which the *Tree* receives its growth in all its parts.

To the 7th. Dr. *Tonge*, The points or ends of the Roots being cut off, they will in proportion bleed as copiously, as the Branches, and probably more; certainly longer, because there is greater plenty of juice ascended above them, than the Branches, and consequently more will issue by them, than by any part of the *Tree*, higher then them.

To the 9th. The same. Trees in their full growth, or near it, will probable yield more sap.

To the 10th. The same. From the latter end of *January*, to the middle of *May*, Trees will bleed. Those, that are said to run first, are the *Poplar*, *Aspe*, *Abele*, *Maple*, *Sicamore*; some, as *Willows*, and the *Birch*, tried by my self, are best to tap about the middle of the second season; and the *Walnut* towards the latter end of *March*. They generally bleed a full Month in the whole. Mr. *Midford* of *Durham*, a very expert Gatherer and Preserver of Saps, affirms, that the Saps of the *Poplar* and *Aspe* rise so briskly in *January*, that they will bleed before the end of that Month. The *Sycamore* will run in hard frost, when the Sap freezes, as it drops.

Fiat Experimentum, Since we are now in that very season, to see whether that early ascent is to be imputed to the forwardness of the year, or not? Let it also be observed, whether the Sap ascends in *Oak* and *Elme*, at any time in this month of *January*; and likewise, which of these three, the *Maple*, *Sally*, or *Willows*, be the most early in yielding of Sap?

And to obtain an Universal and Accurate knowldg of the nature of Sap in Trees, its properties and accidents; Observations and Tryals must be made by a *Number* of men, that have leisure to attend that business daily; which are to examine concerning every Tree;

1. Its Age, Soyle, Situation, &c. the variety of the Ascent of the Sap depending thereon, as on the nature of the Tree it self.

2. The different time of Ascent in Branches, Body, Roots; and of its distilling from cut branches; from roots, not from branches.

3. The Seasons and differences of the time of the year, month and day, in which these accidents happen or cease; whereby it may appear, what to determine concerning them: And particularly, whether that conjecture be well-grounded; which supposes, That Sap does not descend from Trees otherwise than by jellying so as to fail above, whilst there is yet plenty below; as seems to be manifest by the running in the Roots, when it ceases in the Branches.

It were also not amiss to observe, Whether in any Trees, the Sap as to its ascendings, keeps time with the Suns entrance into this or that Sign?

To the 11th. *The same*. The best time of the day for Tapping, is about Noon. In the latter season, when Sap is not very plenteous in Trees, they will neither run morning, nor evening, nor probably at any time of the night; but when they are very full of Sap, and emptied but by small vents, the Sap may run night and day, till exhausted; but never in large vents.

Quere, Whether this Observation may not give light to that Opinion, which holds, that the Ascending of the Sap depends upon the Pressure or Pulsion of Heat, striking the Earth, and thereby driving the moisture of the Earth into the Root?

To the 12th. *The same*. Trees afford no juice at all (that has been observ'd) in *Autumne*.

To the 13th. *The same*. Rain being scarce, the juice will be scarcer. Plenty of Rain can onely give such plenty of Sap, as the pores will admit.

The Answers to the rest of the Queries we reserve for another Month, least these Papers be altogether fill'd with one subject. *Those that have been deliver'd here from Dr. Tonge were for the most part taken out of his Letters to Sir R. Moray, in January, February, March, April, 1666*; at which time he had newly made Experiments about Saps; and are now, after conference with him, accommodated to the Queries formerly made publick.